Residual stress determination in oxidized bulk metallic glass using X-ray diffraction and FIB/DIC methods

Haratian, S.; Niessen, F.; Grumsen, F. B.; Villa, M.; Christiansen, T. L.; Somers, M. A. J.

Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

BOOK OF ABSTRACTS

ISMANAM-2019

26th International Symposium on Metastable, Amorphous and Nanostructured Materials

July 8-12, 2019|Chennai, India

Organized by
Dept. of Metallurgical and Materials Engineering
Indian Institute of Technology Madras
https://mme.iitm.ac.in/ismanam2019

CN-4

Residual stress determination in oxidized bulk metallic glass using X-ray diffraction and FIB/DIC methods

S. Haratian[1], F. Niessen[2], F. B. Grumsen[1], M. Villa[1], T. L. Christiansen[1] and M. A. J. Somers[1]

[1]Materials and Surface Engineering Section, Mechanical Engineering Department, Technical University of Denmark, Kgs. Lyngby, Denmark

[2]Electron microscopy center, University of Wollongong , Wollongong NSW, Australia

E-mail: Sahara@mek.dtu.dk

The presence of residual stresses inside the engineering components generated by local inelastic deformation can influence material's performance considerably during mechanical loading. Surface engineering of ZrCuAl-based bulk metallic glasses (BMGs) by low-temperature (<Tg) gaseous oxidizing is hypothesized to be possible in order to build-up compressive residual stresses in the surface region, which then results in decelerating the shear band propagation during deformation. In the current study stresses introduced as a consequence of ZrO_2 (Al_2O_3) formation on thermochemically oxidized $(Zr_{55}Cu_{30}Al_{10}Ni_5)_{98}Er_2$ BMG were investigated. For this purpose, conventional X-ray diffraction $\sin^2\psi$ and incremental core-ring focused ion beam (FIB) milling methods have been utilized. The BMG was initially oxidized in the controlled gaseous atmospheres imposing an extremely high pO_2 at 600 K for 60 hr. The residual stress $\sin^2\psi$ analysis was conducted on (011) reflection of the tetragonal-ZrO_2 peak where it reveals the existence of compressive stress in ZrO_2. Surface strain relief monitored in high-resolution SEM imaging of a deposited stochastic pattern during gradual milling and measured by digital image correlation (DIC) also indicated the occurrence of compressive residual stresses in the surface region of the oxidized BMG.